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Forest Products Utilization Bulletin

WOOD FOR ENERGY: AN OVERVIEW

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One of the most exciting developments in forestry in recent years is the use of wood industry residues, logging residues, and standing trees to produce energy. Wood for energy promises to help alleviate the Nation's energy crisis, and provide practicing foresters with a new and highly marketable forest product. In a few years, the harvesting of energy wood may be as common as harvesting pulpwood.

BACKGROUND

A review of the historical background of wood as a fuel reveals that its use in the United States peaked about a century ago, when it provided 3 of the 4 quadrillion Btu's consumed by the Nation. Today, energy consumption has risen to 75 quads, and the contribution of wood has decreased to 1.1 quads.

Several events contributed to the reduction in wood fuel use. The development of the coal industry in the Appalachians and the oil industry in the Southwest proved to be the beginning of the switch from wood to cheaper, and more convenient fossil fuels. Natural gas price regulations later caused many industries to convert to this cheap, clean and highly efficient fuel. At the same time, these price regulations severely limited profit opportunities and discouraged the exploration and development of new sources of natural gas. Still later, air quality regulations caused many industries to switch from high sulfur coal, to oil and gas. Environmentalists' pressure against strip mining also helped to accelerate such conversions.

These and other factors have caused shortages of domestic oil and natural gas and led to dependence on foreign supplies. This dependence on foreign supplies did not appear to be a problem until the 1973 Arab oil embargo and the subsequent price increases by the OPEC nations for their oil. Now the country is faced with the serious problems of high prices for fossil fuel, and interruptable supplies. If there was any doubt that this Nation was in an energy crisis, the severe winter of 1976-77, with its plant shut-downs and school closings, very effectively erased it. Industries must now look to non-fossil fuel resources and energy conservation to avoid such costly shut-downs.

Non-fossil fuel energy sources include geothermal, wind, ocean tides, organic gas, solar energy and wood. Research is being carried out on all of these possible sources and more. For example, the Georgia Institute of Technology is doing research on windmills to produce electricity, giant mirrors to capture the sun's rays to produce heat, and the pyrolytic conversion of wood to usable fuels. The United States Energy Research and Development Administration (ERDA) contracted with the Mitre Corporation to study the feasibility of Silvicultural Biomass Farms. The purpose of this study was to assess the potential of wood biomass as a feedstock for producing energy products. The six volumes of findings released by the Mitre Corporation seem to show that Btu farming can be feasible. ERDA has recently contracted the same corporation to install a pilot silvicultural biomass farm at ERDA's Savannah River Plant near Aiken, South Carolina. The purposes of the biomass farm will be to develop experience in energy crop management, refine energy farming operatings, test specialized equipment, and conduct basic research on selected problems. While such a pilot test will include irrigation, fertilization, cultivation, and other intensive farming methods, foresters will recognize it as simply short rotation forestry. Other institutions and research laboratories are studying nuclear energy and other non-fossil fuel energy sources.

If one considers all of the non-fossil fuel alternatives, wood, because of its value, renewability, clean burning characteristics, and availability, ranks high on the list as an extremely viable source of energy.

CURRENT TECHNOLOGY

The technology that produces energy from wood varies in complexity from Benjamin Franklin's stove to modern gasification plants. The production of numerous chemicals from wood, including motor fuels, is technically feasible. However, most of these procedures are currently not economically sound. For example, ethanol can be produced from wood, but it is much more economical to produce it from grain.

A similar situation exists when methanol is produced from wood. A wood-based methanol plant processing 1,500 tons (1,360.8 metric tons) of wood per day at a capital cost of $64 million could produce 50 million gallons (189.3 million liters) per year. At this rate of production and capital cost, the finished product would have to sell for 98 cents per gallon (26 cents per liter). A

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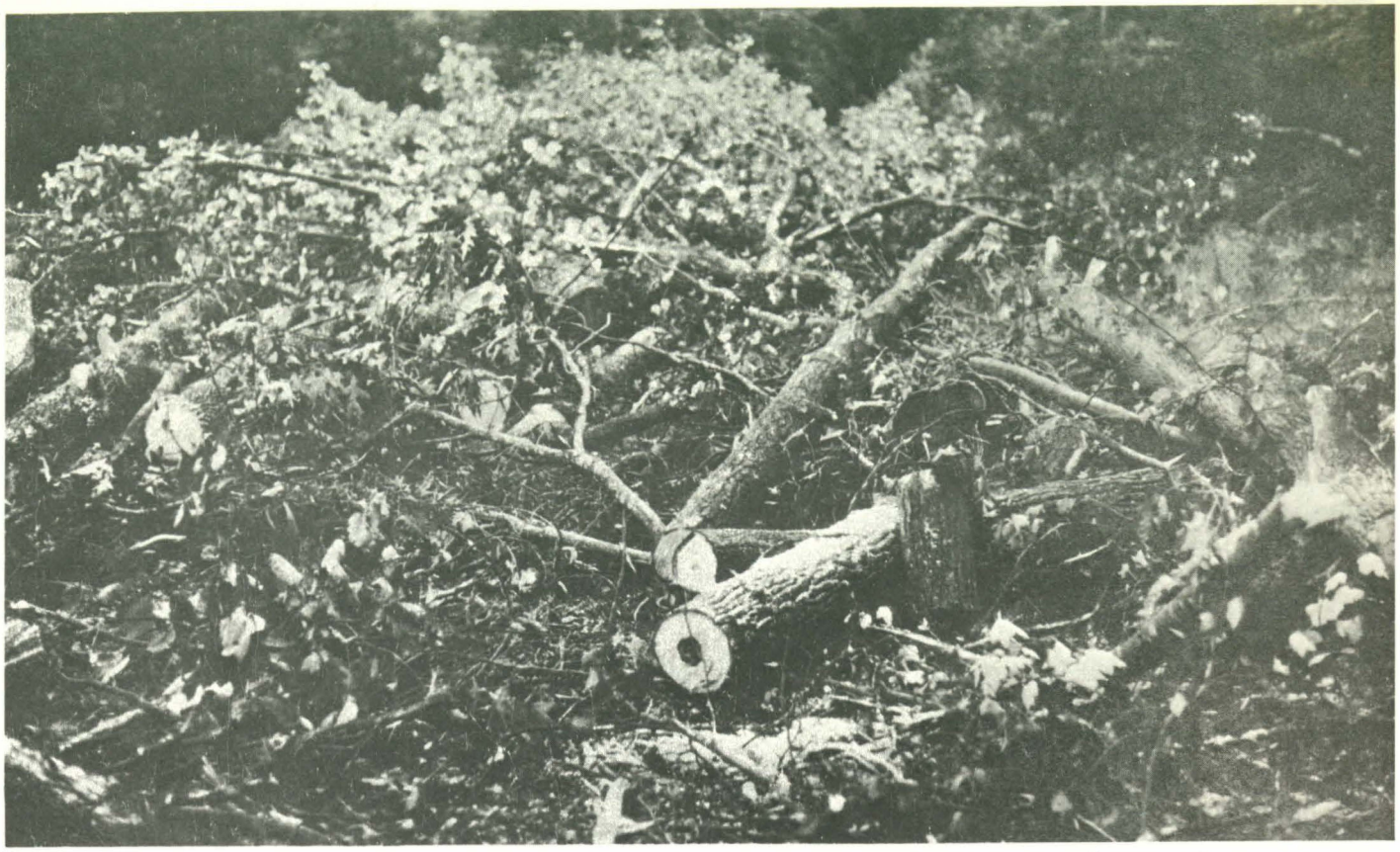


Small trees, limbs, and brush that currently have almost no economic value can, in the future, become a viable source of energy.

comparison of this minimum selling price with the current market price shows that the outlook for the production of methanol from wood in the United States is not good.

There is a brighter side. Industry is currently manufacturing steam, electricity, charcoal, char oil, and combustible gases from wood; and, with current technology, wood is being burned cleanly with little or no pollution.

Numerous conventional boiler systems are now being installed to provide industries with heat, and process steam from raw wood material. These systems are primarily of three basic types. The most conventional system burns the fuel on a grate and then utilizes the heat to produce steam. The other two types of systems burn the fuel in suspension. One of these two systems can be generally described as a cyclonic burner, and the other as a fluidized bed burner. Cyclonic burners usually require dry fuel such as planer shavings while the fluidized bed burns either wet or dry fuel.

These systems, which are rapidly being installed throughout the country, are also capable of producing on-site electricity. Generating electricity in conjunction with process steam is both highly feasible and now being done by industry. At this point, however, it does not appear practical or feasible to produce electricity at large utility generating plants with wood fuel as the primary energy source.

Another method of producing energy from wood that deserves attention is pyrolysis. This system hastens the decomposition of organic material with heat in the absence or near absence of air. The products of pyrolysis are char (charcoal), pyrolytic oil, water and water soluble compounds, and noncondensable combustible gases. Several models of pyrolytic converters are now available, and where there are sufficient markets for all of the products of pyrolysis, these systems can be very efficient.

With these and other thermochemical, aqueous, or combustion processes, it is obvious that the technology to produce energy from wood not only exists, but has become quite sophisiticated.

THE POTENTIAL IMPACT OF ENERGY PRODUCTION FROM WOOD

While the impact of wood energy production on our Nation's energy budget may not be highly significant nationally, it could play a very important role locally and regionally.

Wood is not the Nation's panacea for energy problems. According to scientists at the Forest Products Laboratory, if all of the harvesting residues and all of the unused residues from primary manufacturing plants were used for energy, they would provide about 2.2 quadrillion Btu's, or about 3 percent of the Nation's energy needs. If all of the rough, rotten, and salvable dead trees are included, approximately 5 percent of the Nation's energy needs could be supplied. If one adds wood waste from secondary manufacturing plants, urban wood waste, biomass production, etc., the percentage increases still further.

It is almost impossible to predict the impact on the national energy budget if energy wood were harvested from our commercial forests as a competing product. For

example, in highly timbered areas such as the South and the West, wood could have a tremendous impact on regional energy budgets. This new "energy wood" product could be in the form of total tree chips, total tree hogged fuel, highly specialized chips for various types of burners, or compressed wood pellets.

The final impact of harvesting energy wood from the forest will necessarily depend upon its value and the demand. The value of energy wood based upon its Btu content is well established and will always be relative to the values of alternative fuels. A *Fuel Value Calculator* shows that wood as a fuel is highly valuable when compared to fossil fuels.[1] For example, the *Fuel Value Calculator* shows that if natural gas costs $2 per thousand cubic feet (28.3 cubic meters), energy wood would be worth $14.75 per wet ton ($16.26 per metric ton). The implication here is that energy wood can already compete on an economic basis with sawtimber and pulpwood. At $2 for natural gas and $14.75 for energy wood, sawtimber would be worth $132.75 per thousand board feet, Doyle scale, and pulpwood would be worth $36.87 per cord, delivered, if these products were burned for fuel (table 1).

If natural gas values are extended to $3 per thousand cubic feet (28.3 cubic meters), the sawtimber value becomes $199.17 per thousand board feet, Doyle scale, and pulpwood chipped and burned for fuel would be worth $55.32 per cord delivered.

While heavy demands for energy wood do not now exist, there are indications that such demands could develop. For example, early in 1977, machinery manufacturers reported that they were far behind on filling orders for wood burning equipment. The wood-using industry and many other industries, such as textiles, are switching from fossil fuels to wood. Greater numbers of sawmills, perhaps hundreds, have switched from natural gas and oil to dry wood waste in firing their dry kilns. Examples of this type of conversion can be seen in almost every state. Many wood-using industries also produce steam from wet wood waste such as sawdust and bark. Some plants generate their own electricity. Feasibility studies are now being made for industries which will produce wood energy products such as steam, wood energy chips, wood energy pellets, etc.

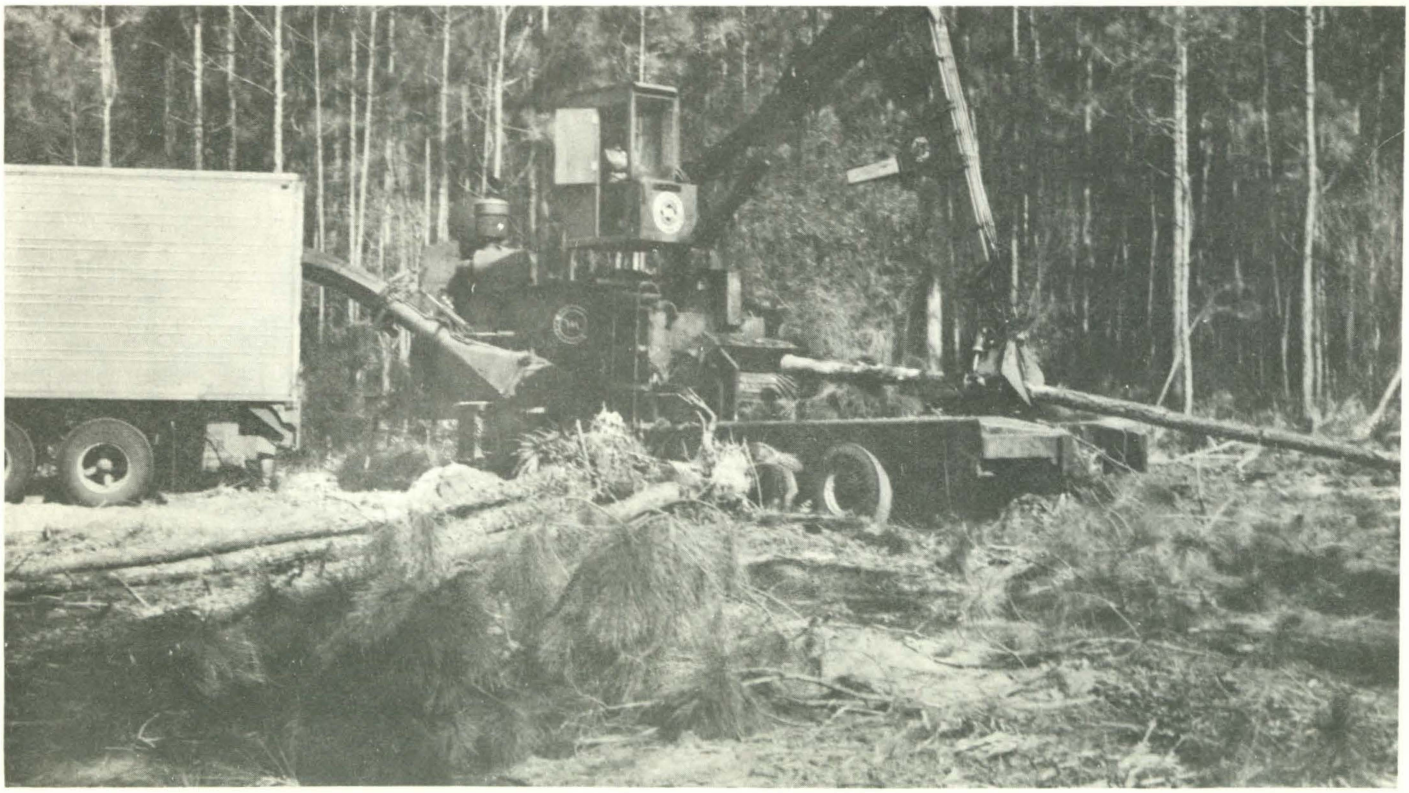
Several universities and other institutions are studying the feasibility of using wood fuel. There is also evidence

Table 1. –The value of energy wood, sawtimber and pulpwood, if used as fuel.

Natural gas costs	Energy wood[1]	Sawtimber[2]	Pulpwood[3]
($/MCF)	*($/Ton)*	*($/MBF Doyle)*	*($/Cord)*
2.00	14.75	132.75	36.87
2.25	16.59	149.31	41.75
2.50	18.44	165.96	46.10
2.75	20.28	182.52	50.70
3.00	22.13	199.17	55.32

[1]From *Fuel Value Calculator.*
[2]Calculated on the basis of 18,000 lbs./MBF Doyle scale.
[3]Calculated on the basis of 5,000 lbs./cord.

[1]Copies of *Fuel Value Calculator,* Publication No. 76-19, are available without charge from: USDA, Forest Service, Information Center, Room 816, 1720 Peachtree Rd., NW; Atlanta, Ga. 30309.



Chipped in the field, this slash becomes easier to handle and more valuable to the harvester.

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that numerous home owners are installing wood burning stoves and fireplaces. Fireplace wood now brings $100 per cord in many urban areas. Advertisements and mail order catalogs today promote various brands of wood burning cook stoves and heaters. Numerous meetings and seminars on wood energy have been held throughout the country and have drawn large audiences.

Should heavy demand develop for energy wood, one can easily visualize both problems and opportunities for the forest manager. With high values for the new forest product and heavy demands, forest managers could encounter abusive timber cutting practices such as clear cutting on steep slopes, erodible soils, etc. However, such high values and heavy demands will probably offer the forest manager many more opportunities than problems. For example, hundreds of thousands of acres of upland low grade hardwoods in the Appalachians, the Ozarks, and other areas could be utilized. This is not to say that all hardwoods in these areas are low grade, but the markets are presently weak or nonexistent for pulpwood-size material. The costs of timber stand improvement and site preparation could be reduced. Logging slash from the West and other areas could be converted to energy – and reduce the fire hazard as well.

Industrial residues such as bark, sawdust, and trimmings will be claimed for energy, first. Then energy wood will be obtained from the forest.

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